

Nyquist Criterion

Mechanical Engineering

Counting encirclements of the critical point to settle stability for good.

Nyquist decides closed-loop stability by counting how the open-loop plot encircles the critical point.

STABLE PLANT, STABLE LOOP

no encirclement at all

VECTOR MARGIN

closest approach to the point

PURE TIME DELAY

rotates the plot

- Unstable roots = encirclements plus open-loop ones
- Count clockwise encirclements of minus one
- Zero unstable roots means a stable closed loop
- It works for unstable and time-delayed plants
- Gain margin is where the plot crosses the real axis
- Closest approach to the point is the true margin

LOOK FOR IT

A pure time delay adds phase lag with no gain change, and eats margin fast.

Nyquist is the general test. Bode gain and phase margins are a convenient special case of it.